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ABSTRACT

One of a series of curriculum guides prepared for the building occupations cluster of the construction/fabrication occupational group, this guide identifies the essentials of the electricity trade as recommended by the successful electrician. An instructional program based upon the implementation of the guide is expected to prepare a student to adequately perform entry level tasks required of an electrician or to enter a post-secondary technical or apprenticeship program in electricity where additional depth can be realized. Trade tasks or information are listed in chart form under the headings of safety, blueprint reading and planning, selection and use of materials and supplies, labor and material estimating, tools and equipment, operations and/or jobs, and general competencies. Space is provided on the charts to record for each item the date completed, teaching methods used, and teaching materials used. Also included are a list of teacher responsibilities, sources of occupational information, recommended tests and references, and a chart depicting the total construction/fabrication occupational curriculum. A typical application for employment and a sample trade and industrial education injury report are appended. (HD)

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TRADE AND INDUSTRIAL EDUCATION

TRADE PREPARATORY TRAINING GUIDE

ELECTRICITY [CONSTRUCTION]

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DEFINITIONS USED IN THIS GUIDE

Major Occupational Group

A grouping of similar and related occupational area clusters. These groups include occupations that have been determined to be the most relevant and pertinent for inclusion in vocational education in Nebraska.

Occupational Area Clusters

These clusters are distinguishable in terms of similar work performed, materials used, products produced, and/or services rendered. They include a wide variety of common occupational skills and knowledge.

Occupation

The career or employment engaged in by an individual for remuneration. This activity includes technical competencies and related technical information often referred to as one's vocation.

Technical Competency

The specific tasks required for a vocational trade and industrial graduate to perform successfully at the entry level in an occupational area. These technical competencies apply to the psychomotor domain and include elements which emphasize motor skills such as: operate a machine; measure; etc.

Related Technical Information

The information the entry level worker must know in order to make appropriate trade decisions which will allow him to adequately perform the tasks or technical competencies of his occupation. This information applies to the cognitive domain and includes elements which are intellectual outcomes such as: knowledge and understanding.

Related General Information

Information which is desirable and good for the tradesman to know but which is not necessary to do his work properly; information that is nice to know, such as the history and development of his trade.

Related Guidance Information

Information that helps the student choose, prepare for, secure, hold, and make progress in an occupation.

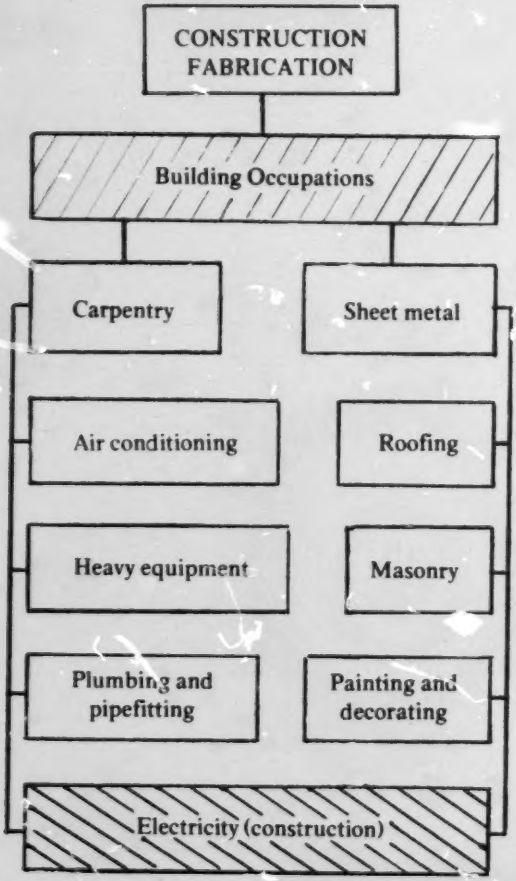
Entry Level

The technical competencies and related technical information deemed necessary by industry for obtaining and holding a job in a specific occupational area. This level of employment includes the technical competencies and related technical information that will be utilized by the employee within the first year of employment.

Occupational Analysis Chart

The chart on the following page shows Electricity as it relates to other occupations within the Building Occupations cluster. Building Occupations is one of two clusters which is a part of the major occupational group entitled Construction/Fabrication. This guide is concerned with Electricity only. Other guides have been prepared for each of the occupations found in this chart and are available through the Nebraska State Department of Education.

OCCUPATIONAL ANALYSIS CHART
[PROJECT MODEL]



INTRODUCTION

This curriculum guide has been prepared with the help of competent craftsmen in the building trades. The funds that made this guide a reality were provided through a federal research grant in cooperation with the Nebraska State Board for Vocational Education and sponsored by the Nebraska Research Coordinating Unit.

Curriculum guides have been prepared for several trade and industrial occupational clusters from which high school teachers can develop appropriate occupational related experiences for their students. The major occupational groups, occupational area clusters, and occupations are shown in graphic form on pages of this guide.

Selection of trades within four major occupational groups have been made based on a three year survey by the Nebraska Research Coordinating Unit on needs of Nebraska business and industry. This study has identified the occupations with the greatest need for employees. A related set of curriculum guides have been prepared for these occupations.

Guidance Information

The U.S. Department of Labor has developed an extremely helpful book entitled, "Occupational Outlook Handbook." This annual publication provides a very complete description of the activities of the persons employed in the occupations represented in the Nebraska trade and industrial curriculum guides. Information concerning current and future opportunities is a major portion of this publication. Inexpensive reprints in booklet form that describe individual occupations are available through the Department of Labor. These booklets should be used by trade and industrial teachers and school guidance counselors for the most up-to-date guidance information about a particular occupation.

A listing of these reprints from the "Occupational Outlook Handbook," the order number, and price per copy is listed below for those occupations in the occupational area cluster of "Building Occupations."

Number	Title	Price
1650-69	Bricklayers, Stonemasons, Marble Setters, Tile Setters, Terrazzo Workers	.20
1650-70	Carpenters, Painters and Paperhangers, Glaziers	.20
1650-71	Cement Masons, Lathers, Plasterers	.20
1650-72	Construction Laborers and Hod Carriers	.15
1650-73	Electricians (Construction)	.15
1650-75	Floor Covering Installers	.15
1650-77	Plumbers and Pipefitters	.15

1650-78 Roofers, Sheet-Metal Workers ..... .15
1650-80 Air-Conditioning, Refrigeration, and Heating Mechanics ..... .10

The Electricity Guide

This guide uses the title Electricity (Construction) as the most logical descriptive term for identifying a particular related group of workers. Identification of specific job titles within this group should be determined by referring to the "Dictionary of Occupational Titles." The USOE classification system for coding instructional programs has assigned 17.1002 to the instructional program, Electricity (Construction).

The information within this guide identifies the essentials of the electricity trade as recommended by the successful electrician. An instructional program based upon the implementation of this guide will prepare a student to adequately perform entry level tasks required of an electrician or to enter a post-secondary technical or apprenticeship program in electricity where additional depth can be realized.

The tasks and/or competencies identified within these covers are those agreed upon by a jury of reputable Nebraska electricians. A separate group of persons directly employed within this trade in Nebraska have further verified these tasks and/or competencies. Jury members, tradesmen, and educators who contributed toward the development of content for this guide are listed in the front.

Course offerings in trade and industrial education in Nebraska are to be organized within two period blocks of time each day, five days a week. Time is to be set aside for classroom instruction directly related to manipulative laboratory in truction. The remainder of the student's school day is to be utilized for general education subjects.

USE OF THIS GUIDE

The use of curriculum guides for trade and industrial education in Nebraska secondary schools may vary greatly, depending upon the depth and breadth of each school district's vocational program. Large school districts, for example, may utilize one particular curriculum guide to develop a course in a trade area such as electricity. A small school district may, on the other hand, incorporate several curriculum guides to develop a course in the building trades occupational cluster.

The manipulative content identified in this guide is deemed necessary for inclusion in a course that is designed to prepare entry level electricians. While not all secondary school facilities in Nebraska are equipped to expose students to all of this content through hands-on experience, it is assumed that this content will through some media become related technical information. This will insure inclusion of all content and provide at least discussion level understanding.

This guide is written with the assumption and expectation that the related technical information necessary to perform technical competencies will be an integral part of instruction. Thus, occupational decisions that must be made by an entry level worker will be developed along with each related manipulative activity.

The electricity instructor who uses this guide is responsible for including the identified related technical information as well as the identified manipulative tasks. He is also responsible for the identification of competencies pertaining to general and guidance information, even though this information is not specifically identified for him.

Definitions for various terms used in this guide are presented in the front.

TEACHER RESPONSIBILITIES*

1. Use the American Vocational Association National Safety Council's "National Standards School Shop Safety Inspection Check List" for shop safety inspections. (Available from American Vocational Association, 1510 "H" Street, N.W., Washington, D.C. 20005)
2. Use safety check list to assure safe factors exist.
3. Require students to report ALL accidents to instructor.
4. Keep complete records of ALL accidents on file.
5. Report ALL accidents to the school administration.
6. Develop safety consciousness in the students through teacher example—always doing things in the safe way.
7. Give shop demonstrations stressing safe use of machines.
8. Give shop demonstrations stressing safe use of hand tools.
9. Provide instruction on what to do in case of an accident.
10. Develop information sheets dealing with the safe use of specific machines.
11. Give demonstrations on the proper use and care of personal protective devices.
12. Develop information sheets dealing with the general safety rules for the trade.
13. Enclose all gears, moving belts, and other power transmission devices with permanent guards.
14. Prohibit students from operating machines when instructor is not present.
15. Prohibit the removal of guards and safety devices, even for a brief period, without the approval of the instructor.
16. Prohibit more than one operator from using a machine at one time.
17. Determine personal liability factors and liability coverage afforded through your school.
18. Provide for the bulk storage of flammable materials.
19. Mark the location of fire-fighting equipment.
20. Post instructions and inform students of building evacuation procedures.
21. Require the wearing of appropriate eye protection as specified by the State of Nebraska eye safety regulations.
22. Keep tools sharp, clean and in good working condition.

*These responsibilities are necessary for inclusion in all trade and industry programs in the State of Nebraska.

23. All shop personnel should be thoroughly familiar with the location of fire extinguishers and the type fire for which each extinguisher is designed.

EI ECTRICITY [CONSTRUCTION] CONTENT
[Identified Trade Tasks or Information]

10

TRADE TASK OR INFORMATION	DATE COMPLETED	TEACHING METHODS USED	TEACHING MATERIALS USED
SAFETY			
Exercise care in handling or using machines.			
Exercise care in handling or using tools.			
Report unsafe conditions to immediate supervisor.			
Recognize safe areas of job or construction site—avoid unsafe areas.			
Exercise care in all operations about job or construction site.			
Use insulated tools and grounding methods when working with electrical circuits and equipment.			
Wear appropriate clothing and shoes when working around high voltage power supplies.			

TRADE TASK OR INFORMATION	DATE COMPLETED	TEACHING METHODS USED	TEACHING MATERIALS USED
Avoid short cut procedures when connecting units to power supplies.			
Correct unsafe conditions of tools and machines.			
Correct unsafe conditions of ladders and scaffolding.			
BLUEPRINT READING AND PLANNING			
Interpret blueprint symbols.			
Read, understand and interpret blueprints.			
Read and use electrical symbols.			
Calculate lighting requirements.			
Use a slide rule.			

SELECTION AND USE OF MATERIALS AND SUPPLIES

Minimize waste of materials.

Select proper gauge wire for specific uses.

LABOR AND MATERIAL ESTIMATING

Calculate number and types of circuits needed when designing wiring systems.

Estimate materials and supplies.

Estimate total cost of job.

Estimate labor.

Estimate costs of installation or repair.

TOOLS AND EQUIPMENT

Use and maintain the following tools and equipment:

tin snips

TRADE TASK OR INFORMATION	DATE COMPLETED	TEACHING METHODS USED	TEACHING MATERIALS USED
wiremold bender			
concrete star drill			
come-along or chain fall			
wire gauge			
micrometer			
portable circular saw			
ladders			
bench vise			
tri-stand vise			
hydraulic conduit bending machine			
reel stand			
hydraulic jacks			
power vise			

stud gun

test lamps

multimeter

wattmeter

ohmeter

ammeter

voltmeter

feeler gauge

steel rule and tape

auger bits and brace

pipe vise

electric drill motor

soldering irons and torches

pipe threaders

TRADE TASK OR INFORMATION	DATE COMPLETED	TEACHING METHODS USED	TEACHING MATERIALS USED
pipe and tubing cutters			
wire cutters			
wire stripper			
OPERATIONS AND/OR JOBS			
Cut pocket for fishing			
Use an engineer's and architect's scale.			
Read and follow circuit diagrams.			
Stop a leak caused by puncture.			
Install bell wire in plaster or wood.			
Fasten lug to wire.			
Construct a cable grip.			
Level floor boxes in concrete floor slab.			
Drill hole by hand with brace and bit.			

Drill hole with electric drill.

Cut out for switch box in finished wall.

Skin wire.

Inspect, service, and replace contact points.

Inspect, service and replace limit switches.

Inspect and repair solenoids.

17 Check, repair, or replace power capacitors.

Repair non-operative or malfunctioning circuits.

Check wiring for overload using inductive ammeter.

Inspect wiring straps and attachments.

Inspect wiring.

Test for proper ground.

TRADE TASK OR INFORMATION	DATE COMPLETED	TEACHING METHODS USED	TEACHING MATERIALS USED
Test for short circuits.			
Check action of switches using test lamps.			
Check circuit continuity with test lamp.			
Connect power cable to electric range motor and install ground leads.			
Wire three and four wire 240 V receptacles.			
Install switches and circuit breakers/fuses.			
Install conduit and conductors.			
Determine conductor size necessary for 240 V receptacle.			
Install high voltage receptacle.			
Splice conductors in outlet.			
Attach conductors to outlet.			

Install conductors inside conduit using fish tape.

Run conduit along branch circuit.

Connect conduit to outlet boxes.

Connect flourescent and incondescent fixtures.

Fasten outlet boxes to studs.

Mark location of switches.

Install concealed wiring.

Connect wires with wire nuts.

Measure, cut, bend, thread, assemble and install electrical conduit.

Install and ground circuit breaker and meter panel.

Construct electrical circuit from diagram.

Install watertight, cast-iron box underground.

TRADE TASK OR INFORMATION	DATE COMPLETED	TEACHING METHODS USED	TEACHING MATERIALS USED
Install adjustable floor box as an outlet or junction box.			
Install non-adjustable floor box as an outlet or junction box.			
Install adjustable or non-adjustable floor box as a telephone or signal box.			
Install gutter box.			
Install standard box as a pull box or junction box.			
Surface mount a square outlet box.			
Surface mount an octagon box.			
Install octagon box as a flush outlet.			
Mount boxes between studs.			
Mount boxes on board supports.			
Mount sectional box on bar hanger.			

Install cable connectors.

Use insulating materials.

Hang fixture tabs.

Mount ceiling light fixture.

Thread conduit.

Tighten and loosen hex head set screw in solderless lug.

Paint outdoor conduit.

Make hanger bolt.

Tap holes for mounting bolts.

GENERAL COMPETENCIES

Apply operational characteristics of inductance and capacitance.

Apply operational characteristics of series and parallel circuits.

TRADE TASK OR INFORMATION	DATE COMPLETED	TEACHING METHODS USED	TEACHING MATERIALS USED
Apply principles of Kirschoff's Laws.			
Apply principles of Ohm's Law.			
Identify various fastening devices.			
Design circuits according to local electrical ordinances.			

Appendix A

One of the primary objectives of trade and industrial education is the successful placement of students completing course work in a specific occupation. The following sample application form is included in this guide with the recommendation that the preparation of such forms become a necessary activity for students in all trade and industrial education courses.

APPLICATION FOR EMPLOYMENT

PERSONAL INFORMATION

DATE _____ SOCIAL SECURITY NUMBER _____

NAME _____ (LAST _____ FIRST _____ MIDDLE _____)

PRESENT ADDRESS _____ (STREET _____ CITY _____ STATE _____)

PERMANENT ADDRESS _____ (STREET _____ CITY _____ STATE _____)

PHONE NO. _____ OWN HOME _____ RENT _____ BOARD _____

DATE OF BIRTH _____ HEIGHT _____ WEIGHT _____ COLOR OF HAIR _____ COLOR OF EYES _____

MARRIED _____ SINGLE _____ WIDOWED _____ DIVORCED _____ SEPARATED _____

NUMBER OF CHILDREN _____ DEPENDENTS OTHER THAN WIFE OR CHILDREN _____ CITIZEN OF U. S. A. YES ○ NO ○

IF RELATED TO ANYONE IN OUR EMPLOY, STATE NAME AND DEPARTMENT _____ REFERRED BY _____

EMPLOYMENT DESIRED

POSITION _____ DATE YOU CAN START _____ SALARY DESIRED _____

ARE YOU EMPLOYED NOW? _____ IF SO MAY WE INQUIRE OF YOUR PRESENT EMPLOYER _____

EVER APPLIED TO THIS COMPANY BEFORE? _____ WHERE _____ WHEN _____

EDUCATION	NAME and LOCATION OF SCHOOL	YEARS ATTENDED	DATE GRADUATED	SUBJECTS STUDIED
GRAMMAR SCHOOL				
HIGH SCHOOL				
COLLEGE				
TRADE, BUSINESS OR CORRESPONDENCE SCHOOL				

SUBJECTS OF SPECIAL STUDY OR RESEARCH WORK _____

WHAT FOREIGN LANGUAGES DO YOU SPEAK FLUENTLY? _____ READ _____ WRITE _____

U. S. MILITARY OR NAVAL SERVICE _____ RANK _____ PRESENT MEMBERSHIP IN NATIONAL GUARD OR RESERVES _____

(CONTINUED ON OTHER SIDE)

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FORMER EMPLOYERS (LIST BELOW LAST FOUR EMPLOYERS, STARTING WITH LAST ONE FIRST.)

DATE (MONTH AND YEAR)	NAME AND ADDRESS OF EMPLOYER	SALARY	POSITION	REASON FOR LEAVING
FROM				
TO				
FROM				
TO				
FROM				
TO				
FROM				
TO				

REFERENCES: GIVE BELOW THE NAMES OF THREE PERSONS NOT RELATED TO YOU, WHOM YOU HAVE KNOWN AT LEAST ONE YEAR.

	NAME	ADDRESS	BUSINESS	"Ex" 9 ACQUAINTED
1				
2				
3				

PHYSICAL RECORD:

LIST ANY PHYSICAL DEFECTS

WERE YOU EVER INJURED? GIVE DETAILS

HAVE YOU ANY DEFECTS IN HEARING? IN VISION? IN SPEECH?

IN CASE OF EMERGENCY NOTIFY

NAME ADDRESS PHONE NO.

I AUTHORIZE INVESTIGATION OF ALL STATEMENTS CONTAINED IN THIS APPLICATION. I UNDERSTAND THAT MISREPRESENTATION OR OMISSION OF FACTS CALLED FOR IS CAUSE FOR DISMISSAL. FURTHER, I UNDERSTAND AND AGREE THAT MY EMPLOYMENT IS FOR NO DEFINITE PERIOD AND MAY, REGARDLESS OF THE DATE OF PAYMENT OF MY WAGES AND SALARY, BE TERMINATED AT ANY TIME WITHOUT ANY PREVIOUS NOTICE.

DATE SIGNATURE

DO NOT WRITE BELOW THIS LINE

INTERVIEWED BY DATE

REMARKS:

NEATNESS		CHARACTER	
PERSONALITY		ABILITY	

HIRED FOR DEPT. POSITION WILL REPORT SALARY WAGES

APPROVED: 1. 2. 3.

EMPLOYMENT MANAGER DEPT. HEAD GENERAL MANAGER

Appendix B

One of the most important parts of any trade and industrial education course is a safety program. The following form is recommended for use in courses of this type.

SAMPLE
TRADE AND INDUSTRIAL EDUCATION
INJURY REPORT* **

Student injured _____ Date _____

Shop in which accident occurred _____ Time _____

Instructor in charge _____

Nature of injury _____

_____

First aid administered _____

_____ By whom? _____

Cause of injury _____

_____

Could injury have been prevented? ____ How? _____

_____

Action taken or recommendations made to prevent recurrence _____

Remarks: _____

_____

_____

Signed _____
(Person making report)

Witnesses: _____

Names _____
and
Addresses _____

*Complete in Duplicate
**File one copy in office

RECOMMENDED TEXTS AND REFERENCES

Electricity [Construction]

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——. *Vocational Instructional Materials for Trade and Industrial Occupations.* Washington, D.C.: U.S. Government Printing Office, Stock Number 1780-0842, 1971. (This book of curriculum materials lists innumerable sources of great value to the T & I teacher. These free or inexpensive materials have been printed by the U.S. Government Printing Office. Your copy of this catalog will cost $1.50 and is available from the following address:

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